



Course Title: Communication systems

Course Code: EEC2247

Second Year

Date: June 24, 2011 (second term)

Allowed time: 3 hrs

No. of Pages: (2)

Answer all the following questions:

Question (1) (20 degrees)

- (1) Find the trigonometric Fourier series for the periodic waveform shown in Figure (1).

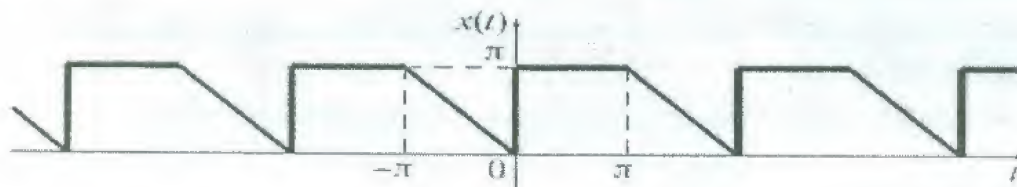


Figure (1)

- (2) Find the complex Fourier series and the PSD for the periodic square waveform shown in Figure (2).

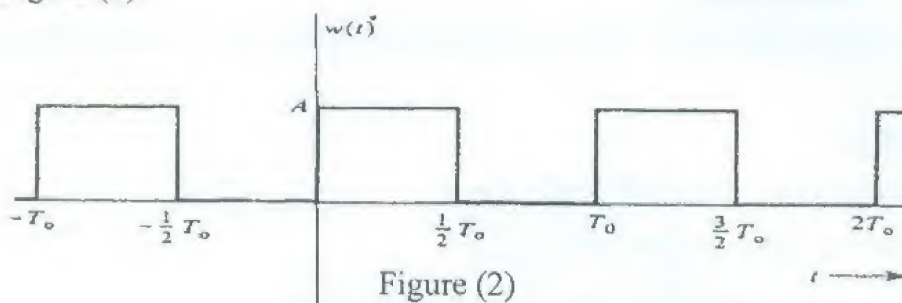


Figure (2)

- (3) Use the Fourier series representation of a periodic train of impulses to prove that

$$\sum_{n=-\infty}^{\infty} \delta(t - nT) = \frac{1}{T} \sum_{n=-\infty}^{\infty} e^{j2\pi n t / T}$$

then, find its Fourier transform and draw its spectrum.

- (4) State the Parseval's theorem and the Dirichlet's conditions.

Question (2) (20 degrees)

- (1) Determine the Fourier transform of the following function:

(a) $x(t) = (\cos(5t) + e^{-2t})u(t)$

(b) $\text{rect}(\frac{t-2}{4}) + 8\sin(6\pi t)$

- (2) If $w(t) = e^{-2t}$, find its Fourier transform, then find $X(f)$ that satisfies the following relationships:

(a) $x(t) = w(2t + 2)$

(b) $x(t) = e^{-jt} w(t - 1)$

(c) $x(t) = \frac{d^2 w(t)}{dt^2}$

Question (3) (20 degrees)

- (1) Explain with the mathematical representation, how the switching modulator can be used to generate the AM wave.
- (2) If a carrier wave $c(t) = A_c \cos(2\pi f_c t)$ is amplitude modulated by a baseband signal $m(t)$, show how you can obtain a DSB-SC wave by using a double balanced modulator.
- (3) For the baseband signal $m(t) = 2\cos(2000\pi t)$, determine the following:
 - (a) The spectrum of $m(t)$.
 - (b) The spectrum of the DSB-SC signal $m(t) \cos(20,000\pi t)$.
 - (c) Identify the frequencies in the baseband, and the corresponding frequencies in the USB and LSB spectra.
 - (d) Show how you can recover the baseband signal from the DSB-SC wave.

Question (4) (20 degrees)

- (1) State the benefits of using SSB modulation over the DSB modulation.
- (2) Shows with the block diagram, how you can generate the SSB wave by using the phase discrimination method.
- (3) A SSB-AM wave is modulated with the baseband signal $m(t) = 5\cos(1000\pi t)$, with $A_c = 1$.
 - (a) Evaluate $\hat{m}(t)$.
 - (b) Find the expression for a lower SSB signal.
 - (c) Sketch the amplitude spectrum of $|S(f)|$.
 - (d) Find the normalized average power of the SSB signal.

Question (5) (20 degrees)

- (1) Design FM transmitter that is based on the indirect method to transmit audio signals containing frequencies in the range of 50 Hz to 15 kHz. The narrow-band phase modulator is supplied with a carrier wave of frequency $f_1 = 0.2\text{MHz}$. Assume the final carrier frequency of the FM required is $f_c = 100\text{MHz}$, the maximum frequency deviation $\Delta f = 75\text{kHz}$ and the frequency of the intermediate crystal oscillator $f_2 = 8.5\text{MHz}$.
 - (2) Show with the block diagrams the types of FM wave's demodulators and the principal of the operation of each one.
 - (3) A single-tone FM signal is given by $s(t) = 10\sin[16\pi \times 10^6 t + 20\sin(2\pi \times 10^3 t)]\text{volts}$. Determine the modulation index, frequency deviation, the carrier power, and calculate the bandwidth of the FM signal using Carson's rule.
-

Good Luck

Dr. Entessar Said